5. Synthesis

The rivers of the study area, though altered since European settlement, still yield relatively clean water and provide high quality habitat for fish, pond turtles, and macroinvertebrates. Urban water pollutants are either shuttled away from the study area via the Long Tom drainage or are diluted by river flows that are supplemented by upstream reservoir releases during the summer and fall. The rivers have low concentrations of bacteria, heavy metals, and nutrients. Reservoir releases of water in the McKenzie River and Middle Fork Willamette River during the summer increase river depth and help keep the water cool.

Amazon Creek, the most urbanized stream in the study area, suffers from high concentrations of heavy metals, nutrients, and bacteria. Along with an excavated channel, increased peak flows, warm water, and piped tributaries, it is habitat to only the hardiest of native fish. Willow Creek, Amazon Creek's relatively undeveloped tributary, still provides a glimpse of the natural condition of foothill and valley bottom streams. Meanwhile, the City of Eugene has learned from a case study on lower Amazon Creek that created wetlands can indeed reduce stormwater pollutants in a stream.

Most stormwater from Springfield flows directly into Cedar Creek, the McKenzie River, Willamette River, or the Middle Fork Willamette River; all are home to spring Chinook salmon and other salmonids.

The study area is served by a joint wastewater treatment plant that yields relatively benign effluent. Fish and macroinvertebrate sampling upstream and downstream of its inlet indicate no disruption of these communities, except perhaps an increase in their density due to the nutrients in the effluent. Other point sources of pollution in the study area seem minor in their influence on the Willamette River.

The three federally listed species of fish that use the study area (Chinook salmon, Oregon chub, and bull trout) owe much of their troubled status to factors outside of the study area boundaries. Yet, the Endangered Species Act does not readily discriminate between major and minor causes of decline and all activities receive scrutiny. Local degradation of Chinook salmon habitat, much of which occurred decades ago, is associated with crowding the rivers with development and refusing to let their channels wander back and forth across the flood plain. Much of the Willamette River upstream of Beltline Road has been reduced to an unwavering simple channel. Evidence that it was once a complex channel studded with gravel bars on each bank is found only in old aerial photographs. Decades of gravel mining at the mouth of the Coast Fork Willamette River and the mouth of the McKenzie River have transformed contorted mazes of side channels into single paths.

Reversing this trend of simplifying river channels and, instead, allowing them more room to wander are limited. Most obvious, a community could choose not to further develop in the flood plains. Common sense might dictate that no building should occur where the river is going to someday flood. Yet, the intensive development of the McKenzie River flood plain upstream of the study area indicates that common sense is not an effective deterrent. A survey of riverfront

homes along the lower 53 miles of the McKenzie River in 2001 indicated that 62% were likely to be flooded by a 50-year runoff event. For over one-third of riverfront homes, the distance to water's edge was less than 100 feet (Alsea Geospatial et al. 2001). Land purchases and conservation easements are another option for preventing development next to rivers. In some cases, removing dikes, opening up old side channels, or connecting shallow gravel mines to the river can increase space for the river to meander and create habitat for fish. However, these activities are expensive.

Given the choice to either protect or restore habitat in rivers, the protection option probably provides the most benefit per dollar spent. And it involves no state or federal permits. The study area includes a number of river reaches with exceptional fish habitat that are currently vulnerable to development. McKenzie reaches upstream of the Interstate 5 would be top priority for protection as is the Willamette River reach immediately downstream of the McKenzie River confluence. Reach 24 of the Middle Fork Willamette River is also undeveloped and contains high quality fish habitat.

Where riprap currently exists along a river, the addition of rock barbs perpendicular to the flow can create micro-habitat that is attractive to juvenile Chinook in the spring and large trout in the summer. The barbs probably mimic a natural feature that was once common to these river channels – large trees with rootwads. Most of the vegetation bordering the rivers is young and too small to be effective in the channel as fish habitat. However, these hardwood riparian stands are common (occupying nearly 60% of all river banks) and fast-growing. If left in place they soon will get large. Tree planting, a time-honored tradition for raising community awareness of environmental issues, should be reserved for riparian areas overrun by aggressive exotic vegetation. As many have found out the hard way, long-term control of exotic vegetation is by far the most challenging part of tree planting.

Oregon chub were not known to exist in the study area prior to the discovery of a small population in small side channels along the McKenzie River in 2001. Other populations probably exist. Similarly, little is known about juvenile Chinook salmon use of the lower portions of streams and off-channel areas of rivers during the winter and spring because these waters have not been surveyed.

The following is a summary list of recommendations and information gaps from the previous sections:

5.1 Recommendations

1. Efforts to protect segments of the river from development would benefit fish most if focused on reaches that currently have high quality physical habitat. High quality reaches include 7, 10-12, and 14 on the McKenzie River and the two reaches of the Willamette River immediately upstream and downstream of the McKenzie River confluence.

2. Efforts to restore segments of the river would benefit fish most if focused on reaches that have the largest difference between historic and current physical habitat quality and have no serious barriers to restoration, such as adjacent deep gravel pit mines or buildings. Such reaches

include 12 and 13 on the McKenzie River and 22 and 24 of the Middle Fork Willamette River.

3. Large wood is scarce in study area rivers. The supply of large wood is limited by reservoirs and it is being removed from rivers as quickly as it enters. Increasing large wood abundance could be accomplished by encouraging the Corps of Engineers to truck wood trapped at reservoirs and put in the river downstream of the dam and by passing local ordinances that prohibits the removal of wood from rivers.

4. Riprap along river banks degrades fish habitat. About 17% of study area river banks are already riprapped. Local ordinances, along with firm enforcement, can be used to limit further expansion of riprap.

5. Peak flows are the sculptors of river channels and much fish habitat is lost when peak flows are muted by upstream reservoirs. While development along rivers prevents a return to historic peak flow regimes, some increase in peak flow magnitude and frequency is possible without flooding downstream landowners. In order to accomplish this, close coordination with the Corps of Engineers and Lane County would be needed.

6. Although tree planting is a common restoration activity, few opportunities exist for planting along study area rivers without first investing in extensive weed and brush control. These efforts need to extend beyond the time of planting in order to avoid tree mortality.

7. Riparian stands along rivers are young compared to historic conditions. Young trees provide rivers with fewer pieces of large wood than do older stands. Trees along rivers are commonly cut for improving views to the river, increasing open areas around houses, or for firewood. Local ordinances can be used to promote the growing of larger trees near rivers, especially native conifer trees.

8. In order to increase the age diversity of overstory species, allow young hardwood stands to mature. This will increase the likelihood of improving riparian function in terms of shade, large woody debris inputs, and wildlife habitat.

9. Because native grass, shrub, and tree species are naturally adapted to habitats within the study area, they require less effort to establish and maintain and provide habitat benefits to wildlife species that are adapted to using them for food and shelter. Therefore, focus on using native plants in revegetation efforts and, as much as possible, on management strategies that mimic historic habitat conditions that supported these plants through flooding.

10. Because an important concern is to offer as much potential habitat to salmonids as possible, focus monitoring, naturalization of flow regimes, and water quality clean-up efforts on channels which currently have the greatest potential to provide salmonid habitat. These are typically unexcavated channels that are closest to the larger rivers. These include, in order of importance:

- Cedar Creek
- Pudding Creek
- Maple Island and Keizer Slough

- Patterson Slough
- Jasper Road, Oxley, and Berkshire Slough

If restoration monies become available, certain channels within the study area would appear to respond more quickly and with greater habitat results than others. Channels that may be suitable for restoration efforts include:

- Springfield Mill Race
- Lower reaches of Willow Creek

11. Natural and constructed ponds that might be suitable for Chinook rearing and the habitat needs of other native fish will be those that are adjacent to the larger rivers or that are closely connected with non-river channels with beneficial habitat conditions. These ponds exist near or are associated with sloughs, including Patterson Slough, Keizer Slough, and Oxley Slough.

12. Peak flow increases due to urbanization cause fish to be displaced in the high-velocity water. Such peak flow increases can be tempered by including well-designed retention basins during initial development and by widening previously-channelized stream channels through excavation.

13. Water temperature data on small streams is lacking in the study area. TMDL processes for temperature are often abbreviated in detail and it is often erroneously assumed that all streams, with enough restoration, can be cooled to 64˚ F. The MECT can prepare for the upcoming TMDL process by monitoring the temperature of Pudding Creek, the only undeveloped stream with flow during the summer. Such monitoring can help counter proposals by others for unrealistic temperature goals that would apply to Willamette Valley streams.

14. Small streams warm quickly even when flowing through short reaches of channel that has full exposure to sunlight. Expanding the cool-water zone within a small watershed is best achieved by establishing shade in the upper portions of the summer stream network and working downstream, making sure that all reaches are shaded.

15. Bacteria contamination within stormwater and smaller receiving waterways is high for both Eugene and Springfield. Reducing bacteria concentrations in waterways can be best achieved by aggressively looking for sources of contamination, including places where sanitary sewers are hooked up to the stormwater system.

16. Streams flowing through yet-to-be-developed portions of the study area will likely take on the characteristics of Amazon Creek if development is not also accompanied by aggressive efforts to treat stormwater before it enters the streams. Constructed wetlands offer a promising treatment option that seems to be at least partially effective in this climate.

17. Sources of high heavy metal concentrations (especially zinc) in some stormwater systems should be investigated with rigor in order to avoid violations of the state water quality standard and harm to aquatic life. The 64th Street stormwater drain in Springfield seems to have the highest heavy metal concentrations and, therefore, should be investigated first.

18. Two populations of Oregon chub have been recently located within and adjacent to the study area. More may still exist. Sites that are favorable to Oregon chub survival (backwater areas with cold water, which helps exclude bass) should be sampled prior to any adjacent development activities in order to protect the last remaining populations of this endangered species.

19. Although there is a legal responsibility to protect habitat for the threatened spring Chinook salmon wherever it occurs, its the rivers and not the streams which provide the best and most extensive habitat for juvenile rearing. Protection and restoration efforts should, therefore, focus on the rivers and especially the McKenzie River.

20. Restoration of Chinook salmon habitat in rivers is costly because it involves rearranging the channel to make preferred habitat features. Natural processes that once did this for free have been truncated by reservoirs and other human activities. Because of the high cost of creating these features, money spent on protecting existing high quality habitat is more cost-effective than restoring lost habitat.

21. Restoration of habitat for Chinook salmon and other salmonids should be directed at mimicking important habitat features that are now scarce. For example, several large logs with rootwads that are secured together at their bases with cable replicate log jams that once provided the nooks and crannies for fish to hide from predators and feed effectively in the current.

22. Efforts to restore wetlands, ponds, and their aquatic biota should include measures to provide safe nesting areas for turtles. Safe sites include islands surrounded by deep water which helps repel predators and non-vegetated areas that allow the sun to warm the soil around nests.

23. Enlisting volunteers to help with the tracking and fencing of turtle nests can greatly improve turtle nesting success.

24. For new projects yet to be implemented, use macroinvertebrate monitoring to assess physical habitat improvement. Suggestions include monitoring:

- Planned restoration site for at least two seasons prior to installation, throughout installation, and then after installation.
- At the same time of the year
- Within similar habitats (riffle/run, e.g.)
- With the same intensity each time

25. Measure and record physical habitat conditions at each sampling site since observed community structure changes can easily be misattributed without an understanding of background abiotic factors,. This will help better account for background variability or conditions that affect the local macroinvertebrate community. Variables of interest would be:

- Substrate size and composition and channel form
- Shade and bank vegetation (understory and overstory)
- Flow conditions

26. Continue to use ABA, Inc. or other similar services whenever possible. Encourage new project managers to do the same. Consistent analysis of samples allows for the comparison of

data throughout the basin. In order to more accurately interpret the quality and healthy of a macroinvertebrate community, project managers should request that new valley floor waterway or river data sets being sent to ABA, Inc. be analyzed using this new bioassessment metric.

27. Except for monitoring to assess restoration efforts, discontinue general macroinvertebrate monitoring efforts on Amazon Creek. This stormwater flow channel continues to be affected by past management decisions and is constricted from any major change by the current urban setting. The aquatic macroinvertebrate communities along the stretches that flow through Eugene appear to be a long way from the point where community recovery would be observable. Monitoring efforts and monies may be better applied elsewhere.

5.2 Information gaps

1. Information on downstream warming trends within undisturbed streams is lacking for the study area.

2. Information is lacking on the sources of bacteria within stormwater. Techniques now exist for discerning whether bacteria is of human or animal origin. Information on the source of contamination can help focus on effective methods to reduce contamination.

3. Ponds that attract high densities of ducks and people are prime areas for bacteria development and transmission to humans, especially to children who play in the water. Information is lacking on bacterial contamination of these waters, which include the Eugene Mill Race and the lower Patterson Slough pond.

4. Constructed wetlands are promising for treating stormwater but the monitoring at existing wetland treatment sites is not sufficient to determine whether they are effective over the long-term. For effective monitoring, information is needed on flow in and out of wetlands, as well as monitoring of sediment deposition and constituents within sediments.

5. The concentration of nitrate/nitrite in the Willamette River downstream of Eugene is low but has increased 4-fold in the last 5 years. This may be due to more nitrogen entering the river from human sources or it could be a result of unusually low flows in recent summers. This question could be resolved by constructing a nitrogen load (by season) for each year using existing concentration and flow data and determining whether or not the upward trend still exists.

6. Information on flow at monitored stormwater sites is missing due to the lack of equipment to measure flows. Proper analysis of stormwater effects on receiving waters requires that flow be known.

7. Juvenile Chinook use of waterways other than the rivers and Cedar Creek is largely unknown for the study area. Current Chinook use of the Alton Baker Canoe Canal, Delta ponds, and the lower ends of Pudding Creek, Spring Creek, East Santa Clara Waterway, and Springfield Mill Race is suspected but cannot be confirmed. Fish sampling of these streams would best be done in March or April during low-flow conditions. Fish sampling should be accompanied by a survey of obstacles to upstream fish passage.

8. The fate of juvenile Chinook salmon that are shuttled into the Alton Baker Canoe Channel at an unscreened inlet is unknown. Information is needed on whether they try to stay in the channel into the summer season and survive bass predation and how many are inadvertently caught during the intensive fishing for hatchery rainbow trout.

9. Not much is known about the site conditions that are allowing turtles to nest successfully in the study area. A comparison of sites that have young turtles with those that have only old turtles may reveal which conditions are critical in this part of the Willamette Valley.

10. Little is known about the macroinvertebrate communities in small Willamette Valley perrential streams that are undisturbed by development. Macroinvertebrate sampling of the undeveloped Pudding Creek would provide this information.

5.3 Ongoing or planned opportunities for habitat protection or restoration

The study area includes a number of ongoing and planned activities for protection and restoration of aquatic habitat. The following provides a summary of the major efforts.

5.3.1 Springfield Mill Race

Water is diverted from the Middle Fork Willamette River into the Springfield Mill Race and the flow is conveyed through a 3-mile-long excavated waterway that follows an old abandoned channel of the river. Flow enters a 30-acre mill pond and then is conveyed downstream through an excavated half-mile-long outlet and enters the Willamette River (Otak 1997). The Mill Race receives stormwater from the southern boundary of Springfield and part of the Mill Race flow is diverted for irrigation of pasture and watering of livestock. The mill pond is no longer used for storing logs.

The Mill Race inlet is simply an open channel that is excavated to the grade of the river. It is located at what is now a depositional area along the river so it annually becomes plugged with gravel and cobble and has to be removed (Klingeman and McDougal 1997). Hardly any flow entered the channel when we observed the site in May, 2002, a time of normal spring flow. Water within the Mill Race and pond warms in a downstream direction and suspended algae makes the water turbid in the pond. The upper Mill Race is bordered by hardwoods and other natural vegetation, but lower reaches are bordered mostly by exotic vegetation. The Mill Race has no functional fish ladder at its downstream that can allow fish to move upstream from the Willamette River, so fish enter only from the inlet on the Middle Fork Willamette River.

The City of Springfield has developed a plan to improve conditions for fish, wildlife, and aesthetic enjoyment by humans of the Mill Race. The plan includes:

- Re-locating the Mill Race inlet upstream to the Clearwater Park boat ramp, a location which would not cause the inlet to readily plug with gravel during the winter.

- Convert areas of exotic vegetation to native plants, especially along the Mill Race so as to improve shading over time.

- Drain the pond, increase the gradient of the mill pond bottom, and confine flow within a created channel that would be beneficial to native fish. Shallow wetland ponds would also be created in the bottom of the drained mill pond. Trees planted along the channel and wetlands would eventually provide shade and moderate water temperature.

- Replace the existing fish ladder with a lower and more effective ladder.

The City of Springfield is currently searching out funding sources for this project.

5.3.2 Willamette River / McKenzie River confluence

The Confluence Group first met in 1999 to resolve a basic problem: how to minimize future flood damage to gravel extraction operations near the confluence of the McKenzie and Willamette Rivers, while enhancing and protecting fish and wildlife habitat. And not just for the short-term, but for many decades in the future. The group consists of representative from local gravel companies, other landowners, the McKenzie Watershed Council, the McKenzie River Flyfishermen, and the various state and federal agencies with responsibilities in the area.

The gravel companies financed a study to model flooding hazard in the area and funding was obtained from the Oregon Watershed Enhancement Board for a study of fish and wildlife, and for designing and constructing some initial restoration projects. The studies revealed where gravel companies were most vulnerable to flooding and the biological study pointed towards where high-value habitat still existed and provided direction about where restoration opportunities existed (Andrus et al. 2000).

Near-term fixes to the confluence area that are being discussed (and now acted upon) include unplugging and constructing side channels and alcoves, designing dikes and riprap to be fish-friendly, connecting some gravel pits to the river, improving nesting and basking habitat for pond turtles, and converting areas with exotic plants to long-lived native trees. Also, conservation easements for exceptional habitat are being explored. For the long-term, they are examining opportunities to widen the active width of the river by proper siting of new gravel operations and integrating shallow gravel pits with the river once sites are mined.

5.3.3 Springfield Park downstream of Hayden Bridge

Weyerhaeuser Company donated a parcel of land along the McKenzie River to the City of Springfield (in reach 10) for purposes of a park. The parcel coincides with an area of high quality habitat for both fish and wildlife. Off-channel features, such as side channels and

alcoves, are common and the land includes a small grove of cottonwood trees that are the largest in the study area (5 to 7 feet in diameter).

The land is undeveloped and the City of Springfield decided not to turn the area into a traditional park with mowed lawn, rest rooms, and roads. Instead, they have designed the park's future to emphasize its wild features and will simply build a few trails for access to viewing areas (Satre Associates 2001). The river will be allowed to spread across its flood plain during high water without encountering hard infrastructure. In the river geomorphology section of this report, we rated this reach as having the best remaining habitat for fish in the study area. Pond turtles are commonly seen in the area.

5.3.4 McKenzie River Trust

The McKenzie River Trust is a program operated by the Three Rivers Land Conservancy whose purpose is to preserve land with exceptionally high ecological values for the future. The Conservancy is a non-governmental organization that works with interested landowners to establish conservation easements, land leases, and land purchases in order to protect parcels of land from development. They are active in the McKenzie River basin and have secured conservation easements for land opposite the Springfield park (reach 10) and recently purchased a large parcel of land on the south side of the McKenzie River in reach 12. This reach was rated as having the fourth highest physical habitat index among all reaches in the study area. The McKenzie River is able to spread widely across its flood plain in this reach and includes a number of side channels and ponds supplemented by cool subsurface river flow. It also includes an extensive area of older hardwood forest.

5.3.5 Delta Ponds

Delta Ponds is a series of abandoned shallow gravel pits (74 acres in total) that are connected to the Willamette River at the downstream end via Debrick Slough. The land, once owned by Eugene Sand and Gravel, was sold at a low price to the City of Eugene in order to provide a place for people to fish. Previous to the sale, an upstream inlet to the Willamette River was maintained in order to provide cool and oxygen-rich water to the ponds. This connection was later neglected and the ponds have became stagnant (Russ Fetrow Engineering and Scientific Resources 1989) and fish populations have declined (John Altucker, Eugene Sand and Gravel, personal communication).

The ponds are currently home to pond turtles, river otters, and some other wildlife (Russ Fetrow Engineering and Scientific Resources 1989), although wildlife diversity is hampered by the dominance of exotic plant species growing within and alongside the ponds and the lack of connectivity between ponds on the east on the west sides of the highway. The Corps of Engineers will fund two-thirds of a project to improve conditions for fish and wildlife in the Delta Ponds and has been preparing a detailed plan over the last few years. The goal for fish is to provide a slow-velocity area during non-summer months to find refuge and feed. The City of Eugene will fund the other one-third of the project. Project costs are estimated to be $5 million.

The project plan is long overdue and the Corps has provided few details on certain specifics of the anticipated activities. However, in general, these activities will include:

- Re-establishing surface water connection among the various ponds and the river.
- Convert areas with exotic vegetation to natural vegetation.

The Corps of Engineers has not indicated how they will deal with the heavy metals that contaminate sediments in portions of upper Debrick Slough and possibly the Delta Ponds.

5.3.6 West Eugene wetlands plan

The West Eugene wetlands plan was developed in response to expanding development along the western fringe of Eugene and the realization that extensive areas of wetlands, some with endangered and rare plant populations, were in the path. The plan was developed beginning in 1989 by citizens, city staff, local officials, and property owners and adopted in 1992. The plan integrates wetlands protection with development in west Eugene. A formal partnership was formed between the City of Eugene, Bureau of Land Management, the Nature Conservancy, Oregon Youth Conservation Corps, and the Corps of Engineers to manage the wetland program.

The plan provides for acquisition of wetlands and adjacent uplands for public and non-profit ownership and dictates zoning ordinances that protect wetlands and waterways. The plan increases certainty for developers by letting them know where wetlands will be protected and where fill and development is allowed. A wetland mitigation bank was established that allows developers to purchase credits in lieu of doing private mitigation. As of 1998, 2200 acres in west Eugene are now in public and non-profit ownership, with 1400 of those acres being wetlands and adjacent wetlands (Lane Council of Governments 1999).

5.3.7 Buford Park

The Friends of Buford Park and Mt. Pisgah have developed a plan to re-introduce channel complexity to a site along the Coast Fork Willamette River at Buford Park. The plan calls for reopening blocked side channels that dissect the 200-acre South Meadow area. A section of an old Corps of Engineers berm at the upstream end of side channels will be removed to allow flow to enter at higher water, road fills and their culverts will be removed from the side channels, and an excavated backwater area will be excavated at the downstream end of South Meadow. The goal is to allow the river to spread laterally during higher flows and allow fish to find refuge and seek out food.